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ABSTRACT

To effectively handle changes in health policy and health information, new designs and applications of automation are explored. Increased use of computer-based information systems in health care could serve as a means of control over the costs of developing more comprehensive health service, with applications increasing not only the automation of hospital operations and the data needed for clinical decision making, but completely new programs for meeting and managing the client population and remuneration of physicians. This series of articles considers various aspects of the application of computer technology to medicine, from the large scale down to the level of the small group practice or solo practitioner. Topics discussed are: (1) modern health care and medical information; (2) the medical record; (3) methodology and long term applications; (4) protection of health care confidentiality; (5) what the users think; (6) what the computer can do for the primary care physician; (7) problem oriented medical records for family practice; and (8) impact on the medical profession. A discussion of the various reasons why many of the more ambitious projects to date have ended in complete or partial failure is included. (Author/JPF)

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INFORMATION SYSTEMS

MODERN HEALTH CARE AND MEDICAL INFORMATION

J. F. Brandejs; And Others

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Information systems, Part I: modern health care and medical information

By J.F Brandejs, PhD, Margaret Ann Kasowski, MSc, Graham Pace, MD

Modern health care delivery is based on the premise that individuals and families can obtain initial and continuing care which meets acceptable standards of quality. Such care should be provided in an appropriate manner, in many cases through a team of health professionals working in an accessible and well-managed setting. For example, a community health centre may form a responsive and accountable primary health service system. Further, modern health care must be effectively coordinated with social and related services to help individuals, families and communities deal in a humane way with multicomponent problems.

At the same time, concern is growing about the accelerating rate of spending in health services which brought Ontario, for example, close to a crisis situation at the end of 1972. Canada, as H. R. Robertson has noted, "... is not alone in its concern about the steady and rapidly increasing proportion of the national effort that is devoted to providing care for the sick; for many other countries with widely different systems (notably Great Britain, France, Switzerland, USSR and the USA) have noted with some alarm their own similar situation, and each is seeking ways of making its services more efficient and less costly."[1] During 1955-67, the average rate of annual increase in the cost of providing all health services in Canada was approximately 11%. Since then, the rate of increase has been averaging well over 11%; for 1971 the indicated rate of increase in the expenditure on acute hospital care was up to 14%, with further increases, because of double-digit *inflation, foreseeable.*

In addition to the cost problem, we need more efficiency in teaching, medical research and practice and even in everyday clinical decision-making.

Brandejs

Technological advances will increasingly affect training and licensing of medical manpower. Analysis of patient care is needed to ensure adequate training of doctors.

To be able to respond to changes in community health indices there must be continuous evaluation of health services. Properly organized and supervised, the integrated health system and team approach that are used in group practices and community health centres can facilitate the monitoring of changes, the communication of new knowledge and methods and the evaluation of results of services and the wants and needs of the clientele.

Experience in many hospitals, clinics and group practices has shown that, as well as better monitoring, better cost-benefit ratios are possible through the employment of professional administrative personnel, modern records and communications, bulk purchasing of prepackaged drugs and the fuller use of special facilities (laboratories, x-ray, rehabilitation, pharmacy, etc.). Well-organized health centres make possible these measures but their full economic benefit comes only when their use is allowed to spread throughout the health services system.

From these considerations it is evident that proper organization is crucial to a well-run health care system, and good records are crucial to proper organization. However, present records are in large part based on handwritten notes and files. Written records, the basis of most medical systems, are often poorly kept. The question is how to stimulate better record-keeping when the information system is not an elegant research project but just plain hard work.

To be viable, a medical information system must be organized, acceptably legible, inexpensive and useful — that is, the physician can find quickly the information he needs.

The growing tendency for family medicine and primary health care to be institutionally or group-based has placed increased emphasis on the medical record as the central instrument for continuity of care. The medical record is also a potential source of data for audit (peer review) and evaluation and for more rational patient and administrative management.

Problems of adapting information techniques to the needs of medical health care systems are complex. An even greater difficulty is the scepticism to be overcome before most practitioners are likely to adopt such techniques.

Medical doctors involved in automation of health care, although constantly increasing in numbers, are still pitifully few. Medical and health care information systems have yet to gain general acceptance; however, most health economists, computer and system scientists and medical administrators maintain that the only way to meet the urgent needs of health care decision-making is to implement viable computer-aided information systems.

Prefer people to systems

In seeming opposition to the above is the view of many patients who find medical "systems" expensive, impersonal, fragmented and difficult to enter. These prefer an able and interested family doctor who will provide continuing care for them and their families, recognizing that each patient is a whole, standing in persistent and perverse opposition to the focus of the specialist. The recent sharp increase in medical graduates choosing family instead of specialized practice reflects recognition of this public demand and a commitment in the young medical generation.

Institutions and industries that spend less than 5% of their overall production for research and development are prone to failure in free-market societies. Both Canada and the US spend 1% or less of their total health care bill for research. Perhaps therein lies the reason for the harsh criticisms of US and Canadian health "industries" — because by not spending enough on research into health care they are, therefore, unable to control changes in the system, including the following now in progress:

- Extension of a single standard of health care to the entire population, with varied mechanisms of funding (in US) and government comprehensive coverage (in Canada) in both the public and private sector.
- Increasing concern for social and environmental aspects of health problems.
- Conceptual enlargement of "medical care" to "health care" with growing application of preventive care and patient education.
- Development of diverse models of health delivery, particularly various forms of group practice.
- Training of more family physicians to provide comprehensive care to families and to integrate the complex maze of specialized health services.
- Definition of new categories of paramedical personnel.
- More concern with quality control and proper use of health services.
- Continuing inflation of health care costs, involving difficult value judgements on allocation of relatively scarce resources and services.
- Increased coordination of services and equipment among hospitals.
- The rise in importance of health planning agencies and the inclusion of the consumer in health care decision-making.

Computer-based system provides instant access to masses of data

To handle these changes, governments are looking for new system designs and applications of automation, as a means of control over the costs of delivering more comprehensive health services to a vastly increased number of people. These sought-after means of control include not only the automation of hospital operations and the data needed for clinical decision-making but completely new programs for meeting and managing the client population and remuneration of physicians.

Computers have been proved helpful in science and industry wherever decisions must be made from masses of random data or there is a need for speed and accuracy, or large amounts of information have to be stored and retrieved. As these qualifications describe the everyday practice of medicine, the computer could prove adaptable and useful even to the work of the individual physician; indeed already there is proof that this can be accomplished.[3-5]

In conclusion, difficult years of rapid changes are ahead for medicine in Canada, the US and elsewhere. It is to be hoped that these changes will be well planned and responsive to society's needs, and that policy-making is not left solely to the legislators. Health policy and its basis, health information, can probably only be rationally reorganized through an increasing use of computer-based information systems in health care. However, this reorganization, if it is to succeed, will require the joint efforts of all parties concerned — planners, health professionals and consumers.

It is the aim of this series of articles to approach this end by considering various aspects of the application of computer technology to medicine (from the large scale down to the level of the small group practice or solo practitioner), including a look at various reasons that many of the more ambitious projects to date have ended in complete or partial failure. Through this sort of analysis, existing misunderstandings and prejudices on all sides may be recognized, so that the remaining serious and differing points of view can be discussed objectively in a spirit of cooperation and realism.

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Information systems. Part II: the medical record

By J.F. Brandejs, Ph D, M.A. Kasowski, M Sc, Graham Pace, MD

In early civilizations, such medical records as existed were linked with religious practices and handed down by "healers" through word of mouth to the next generation.

It was the Greeks who really started medical recording, carefully observing illness and correlating the findings. The records, certainly for brevity and essential data, remain an excellent model for today's practitioner. It is unfortunate that Galen of Pergamon, who in the 1st Century AD developed a system of medicine and theory of disease based on his predecessors' observations and those of his practical experiments, did not establish a school, for following his death there was no one to carry on this tradition.[1]

Further development of medical records had to await the Middle Ages; this development included a more detailed record of the natural history of disease and use of medical data to explain recurring phenomena such as epidemics. During the Renaissance there emerged new attitudes toward science and toward the importance of recording measurements of size, shape, quantity and motion as primary quantities.[2] In the application of statistical techniques to medical data, important developments in the late 19th Century were shared by England and France. During this period, Lois, Pearson, Snow and many others showed that medical records could be used to guide the course of preventive medicine, and they stressed the importance of analysis of simple medical data.[3] By the beginning of the 20th Century, medical records incorporated a great deal of investigation, not only of physical signs, but also of pathology. For example, Walter Cannon's idea of the steady state and homeostatic principle, where agencies interact so as to maintain an equilibrium, is an important development in relation to medical information, which is in effect recording perturbations of the steady state.[4]

To structure modern medical data bases, a thorough study of patterns of practice is necessary. For example, a hypothetical analysis of a family physician's activity would indicate:

- He sees all members of the family of all ages and both sexes.
- He has direct experience with primary or first contact care of unselected patients.
- He has the opportunity to follow all of his patients.
- He brings a multidisciplinary approach to health care.
- He sees patients in some or all of the James stages.[6] These four stages are foundation of disease, preclinical disease, treatment of symptomatic disease and rehabilitation and management of medical conditions for which biologic cure is not possible.

Continuing the analysis, consider just some of the office procedures in a family practice. Preventive medicine includes complete history and physical examinations, well-baby care, prenatal care, immunization and precoronary prophylaxis. Common diagnostic procedures include allergy skin tests, tuberculin and other skin tests, selected laboratory tests, biopsy of cervix, skin, etc. (punch and excisional), pulmonary function testing, tonometry and sigmoidoscopy. Therapeutic procedures encompass setting and casting of selected fractures and sprains, treatment of minor injuries and burns, removal of conjunctival and superficial corneal foreign bodies, removal of foreign bodies from skin, nose, and so forth, repair of lacerations and control of epistaxis. Finally, the family doctor's office practice includes rehabilitative work such as counselling and exercise programs.

From even this partial list one can see how much organization is needed for a good system of medical records. The final analytical step involves this organizational work. If a generic approach[6] is adopted, the components of family practice are the evaluation of symptoms, signs and diagnostic tests (derived largely from internal medicine), the prevalence, incidence, distribution and natural history of disease (derived from epidemiology), the physical and mental development of human beings from intrauterine to adult life (derived from pediatrics and psychology), human behaviour and psychodynamics (derived from psychology and sociology) and social influence in the presentation of disease.

No easy answers

The computerization of medical records is one of the most controversial aspects of health information systems. The problems are both general and specific; no easy solutions exist. At the core of the controversy is the problem of coding, that is, the input of data in a machine readable form. The viewpoint runs the gamut from the use of completely free-form to very restrictive coding procedures.[7,8]

The reason for the development of data bases is that physicians cannot rely solely on their memories to provide them with the right data for the right patient at the right time. The methodical collection and storing of these data will prove the legendary memory capacity of the old family doc to be exactly that — a legend. It has been realized that the patient's medical record must become the chief tool with which the physician works in managing sequentially the problems of every patient. Current hospital records, for example, maintained for each admission, are an entity unto themselves. They do little to prepare the physician realistically for seeing the same patient with one or more problems year after year.

The Kaiser Permanente group was among the first to experiment with the practical automation of medical records. The group gave insight into the software requirements of a large instal-

lation geared to providing for each staff member's needs. Three distinct areas exist in the records: identification, administrative data and medical data.*

A physician cannot use engineering logic to write his case history or to record his physical examination because the requirements for a medical data base differ somewhat from those for most computerized data bases. The work of physicians is neither abstract nor hypothetical. For example, a family physician's day may include an obstetric delivery, a counselling session for a marital problem, a tonsillectomy, a closed reduction of a Colles fracture, management of an acute coronary and diagnosis of an unsuspected hypertension by a routine physical examination. Under these circumstances, the best approach is through computerization of a summary; this reduces the volume of data and avoids misinterpretation caused by the wide variety in terms.* The procedure expedites computer searches, indexing and retrieval. The following structure and format is suggested: what (complaint), where (location), kind (degree or type), when (onset and cause) and prognosis (result of treatment and unfavourable courses). Work along these lines is being undertaken by Dr. Léonard Roussel at the University of Ottawa and by the College of Family Physicians of Canada.

Getting nongarbage data

The major problem of computerizing medical records is generally recognized to be how to deal with verbal information. Because medical interviewing is the normal basis by which information is gathered, the validity of data so collected deserves thought; it is discouraging to consider the amount of time devoted to medical interviewing when so little is known of the validity of questions used in the process.

A question is reliable when (assuming there is a variance in initial responses between patients) patients respond consistently to it over time. It is relatively easy to obtain reliability, as compared with validity. (Jack Benny's age was a reliable 39!)

If we use no standardized wording of questions, this may be an important source of bias. In addition, nonverbal cues, such as facial expression or gesticulation, which vary from interviewer to interviewer, may be a mechanism for bias by communicating to the patient the relative importance of the item or implying to him that his preceding answer was somehow unacceptable and should be changed.

There are two types of questions: closed questions, such as "are you suffering from a headache at this time?" and the open-ended format, "what seems to be the trouble?" Open-ended responses are generally difficult to deal with, record and analyse. The chief complaint about open-ended responses is that they are clinically useless.

Illness, fatigue, drugs, anxiety, stress, physical discomfort and other such factors all may increase the possibility that questions will be answered without being properly understood.

Physician history-taker

The extent to which medical data are valid depends to a large degree on the physician himself, reflecting his prowess as a history-taker. His understanding, attitudes and ability are critical.

To manage a patient successfully, the physician needs to understand his own feelings toward those patients he would normally reject, those patients to whom he would become hostile and those patients to whom he would have positive feelings of love. He must understand defence mechanisms and how they are used by patients in health and illness and the feeling and reactions of patients toward himself and those working with him on the health care team. He must know when and how to use various interactions with patients, such as empathy, confrontation, interpretation, reflection and silence. He must be able to recognize when behaviour exceeds the limits of normal behaviour and understand the cultural, social, psychologic and physical factors affecting health and illness. Finally, an understanding of mature interpersonal and sexual behaviour and the placebo effect of medications and/or interpersonal interaction form part of the requirements of the physician.

The physician's attitudes must be such that he finds something to respect in every patient, he views patients as human beings and not as disease carriers or interesting cases, he accepts that illness includes a patient's failure on the job, deviant behaviour or unhappiness in addition to pain and abnormal pathology and he perceives the difficult patient as a challenge of medicine and as his personal challenge.

Finally, the completeness and accuracy of the resultant history depend on the physician's ability to conceptualize his questions, state them logically and unambiguously and precis the essential data, combining this with his physical observations.

Assuming that the basic data collected meet adequate standards of quality, one must then consider how best to process this information. Several computerized hospital systems have already been successfully implemented in Sweden (e.g. the Danderyd and Karolinska hospitals).[13] These have proven that the specifications drawn up by the Swedes, after careful study of systems all over the world, may be accepted as realistic, general guidelines for other countries. If possible, systems should allow storage of all information about the patient on a computer-oriented medium — magnetic tapes, discs, drums, etc., and use of various kinds of input media (cards, paper tape, optically readable sheets or cards, terminals, and so forth). Every item of information about a patient should be retrievable; output should be completely verbal and readable by anyone and should not require knowledge of computer technology or the code used. Processing of all information should be by statistical or nonstatistical models. Routine entry of new data (that not requiring extra programming work unless new system functions are needed) should be possible. Codification of information is desirable; however the system should be able to handle in addition coded information, code numbers and free text at random. Access time to data would depend on the type of application, but it must be within clinically reasonable limits. One to 3 seconds is acceptable.

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*Since 1961, the American Medical Association has been working to develop a single language of medicine. It has published four editions of its Current Medical Information and Terminology (CMIT) and two editions of its current Procedural Terminology (CPT). The AMA is currently looking into the possibility of combining the features of both CMIT and CMP to develop a common medical language compatible with computer technology.[10] There is considerable debate over the issue of nomenclature, terminology and coding, especially with respect to compatibility among the most widely used systems of medical recording. The plea has been made to consolidate or integrate all of them into one system, with the suggestion that the final result be called a Systematized Nomenclature of Medicine (SNOMED).[11]

Information systems. Part III: methodology and long-term applications

By J.F. Brandejs, Ph D, M.A. Kasowski, M Sc, C.E. Doyle, FRCS [C]

Traditionally, medical information has been collected on the basis of problems physicians wished to discover. Virologists have obtained throat washings, stool specimens, and antibody titers, while cardiologists have accumulated electrocardiograms, phonocardiograms and vectorcardiograms. Each practitioner has set his own priorities.

But what of the future? In addition to assuring more uniformity of practitioners' data, a properly defined medical data base will offer a wide variety of benefits. Most important of these will be an aide-mémoire to an individual doctor on the general health status of his patient; there are also the possibilities of cumulative use over a range of patients (such as a family), feedback on the results of various methods of treatment, the capability of analyzing data as they arise in the medical record, and the means to search for correlations of symptomatic and therapeutic patterns.

Once a physician has decided which data to collect, he often assigns the task of collecting the data to paramedical staff and concentrates on the remaining phases of health care — defining the problems, developing a plan for each and subsequent follow-up. In family practice, as in other clinical centres, paramedical personnel could routinely collect, on all patients who come for complete health screening, information on height and mass, blood pressure, radial, posterior tibial and dorsalis pedis pulses, visual acuity, ocular tension, stereopsis, colour vision, hearing (by audiometry and inspection of auditory canals if hearing is diminished) and ventilatory function (peak flow, vital capacity, maximal expiratory flow rate). This approach not only frees the physician for more serious tasks, but, as all the tests would be performed routinely on each patient, he is assured a uniform data base with which to work.

Once obtained, most medical data have been handled in the past by unstructured methods, with reliance on anecdotal patient records, sometimes only in the memory of the physician. Such records cannot provide data of the range and precision needed for many clinical decisions, nor are they adaptable as input to present and future information processing systems. Admittedly, medical data are recorded primarily by the physician for his use in treating the patient; however, they should be documented clearly enough to permit periodic audit by other physicians and review of the data for progression or regression of disease.

Planners of medical information systems distinguish three types of medical data — hard, relatively hard and soft. Hard data, which represent about 20% of the total are information gained by computing or measurement. Soft data (about 55%) include historical statements by patients. The remaining category of relatively hard data (25%), while factual, is neither numerical nor narrative.

This variability poses a major problem for system designers, as the classic theoretical models of data collection, using completely structured languages, cannot process soft data. To this problem one must add the additional dilemma posed by the many errors, factual and formal, which all patients make. Mistakes may occur in data collection by incorrect diagnoses or mixing up of samples, data fixation (transcription errors and omissions) or data processing (coding or punching errors). Many errors are of direct human origin, such as incorrect observations, omissions, misunderstanding of questions and straightforward fictitious entries, while others stem from system faults, such as fallible methods of identification.

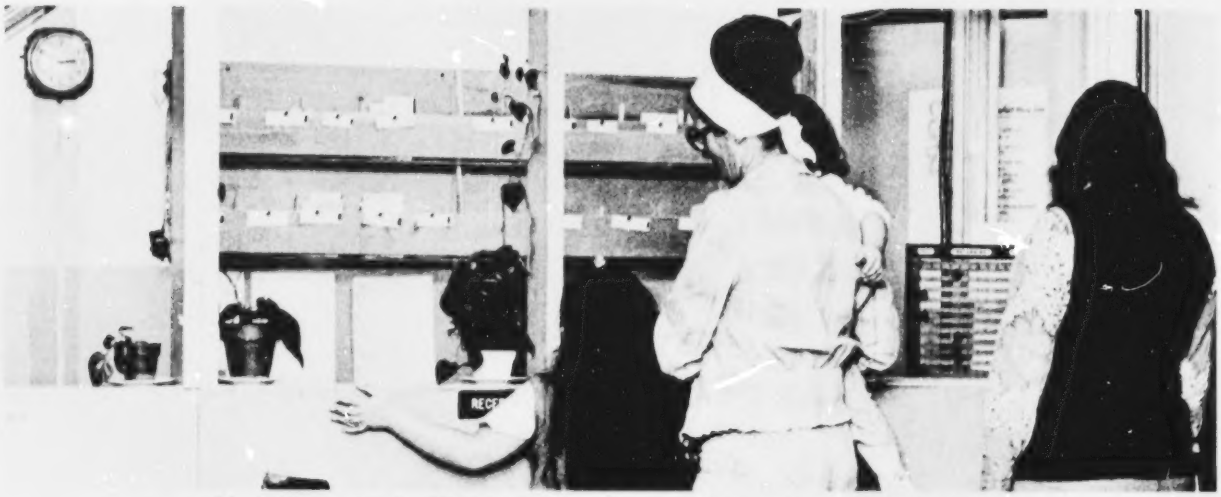
Not all errors will affect a patient's welfare seriously, but they are liable to mislead subsequent investigation and analysis. Hence the overall problem in collecting health care data is how to enter narrative, free-text, soft data in computer-acceptable form, with the least possibility of error and without imposing unduly on the physician or the public purse.

As one step toward this end, automated histories have been developed. Many techniques have been used, but all are aimed at minimizing the time a physician must spend in obtaining and recording a patient's history, while providing a standardized record for each patient.

One simple method consists of sorting preprinted punch cards into yes or no piles. In a more sophisticated setup, a computer displays a question with a series of multiple-choice answers, from which the patient selects the most suitable by pressing an appropriate button. The computer then chooses the next question based on the patient's previous answer. Thus, the question set is tailored for each patient. Those areas with positive findings are explored in depth and those with negative findings are passed over. Studies have shown that while patients may enjoy responding and feel they are able to give a complete history, physicians are more equivocal in their reactions.[1]

There has been no definitive study on the reasons for the dissatisfaction among the physicians. However, it has been observed — notably by a member of CMA staff* on a visit to El Camino Hospital, California — that some doctors feel too much data are presented in a form which calls for further examination, whereas the individual physician in his own history-taking will

*R.W.P. Kaluski, director, department of practice management.



Much information is collected routinely by paramedical staff, especially in clinics

often eliminate various findings as insignificant and consequently not record them. Although the computer cannot make such decisions, one clear advantage of selfadministered questionnaires and automated history-takers is that, whatever bias is present, it is the same for all patients and unchanging with repetition. Another frequently raised criticism of computer-based history-taking is the insensitivity of the machine to nonverbal information from the patient which may be of diagnostic help to the physician. Actually, while there are references in the psychological literature to the biasing effect of verbal and nonverbal information emanating from interviewers, the utility of nonverbal patient information to the physician is doubtful.

At present, several forms of automated multiphasic screening and history-taking are being extensively tested on patient populations to modify, perfect, and evaluate them. A more detailed look at one such system (PROMIS II) will be included in this series.

From a long-term perspective, there still exists a host of conceptual and technological problems in the management of large and complex medical data bases. Their future development and improvement depend, not only on achievements within the computer and communications industry, but even more on human factors, including acceptance of computerization and the willingness of physicians to use online terminals linking their offices with powerful supporting technology. In turn, systems experts must be able, not only to analyse the nature of medical information, but to truly understand the behaviour, needs, and working conditions of the medical personnel. Doctors are going to use terminals and other systems linking them with computerized data bases only if linkage of individual patient files into an integrated life-long file will be of significant value to them.

The interface between man and machine will continue to change. So will the values, requirements, wants and needs of physicians and patients. Medical users will not fully accept computerized medical and health care data bases as the core of restructured, district-oriented health care delivery systems, without a series of programs in continuing education.[3]

Computerized medical and health care data bases must be able to store data and free-text information, as both are needed to support medical decision-making. As well, it should be possible to record information to provide prediction value, by incorporating a feedback process. Then, physicians could use stored data to influence the direction of future patient management. At the Karolinska Hospital, Stockholm, data have been accumulated and analysed for many years, and a system of weightings has been developed for various data — type of operation, age, nonsmoker, cancer, asthma, etc.

Incorporation of such decision support systems in computerized medical data bases is a major objective of present research and development. This is a key step toward an elusive goal — objective measurement of the quality of health care.

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Information systems. Part IV: protection of health care confidentiality

By J.F. Brandejs, Ph D, M.A. Kasowski, M Sc

Probably few issues present so fundamental a contradiction as the right of an individual to freedom from intrusion versus the right of society to be sufficiently informed to protect itself. An act of the US Congress in 1890 secured: "for each individual the right of determining, ordinarily, to what extent his thoughts, sentiments and emotions shall be communicated." In direct contrast, it has been noted[1]

> In legal terms, there is no absolute right to privacy. Privacy implies a relationship of the rights of the individual to rights of others. For example, even though a man has an interest in the inviolability of his home, there is a constitutional authorization for reasonable search and seizure to serve the public's interest in obtaining evidence of a crime. In terms of a computerized health information system, there are several interests that could be in apparent conflict: on one hand, there are the health planning needs for the population or the need to monitor health care for certain persons; on the other hand, there are the individual's interests in privacy and the confidentiality of his communication with his physician. In the event of conflict, the courts must decide which outweighs which . . . Even though the challenge of computer technology has not yet been met by the courts, they have ruled on the protection of some privacy interests (i.e., mainly private property and business interests), the protection of medical information and the confidential nature of the doctor-patient relationship.

Hesitant acceptance

Let us look specifically at confidentiality of health care data. Although the United States public has been reluctant to agree to governmental computerization of medical information, in Canada the automation of physician payments by provincial government-run medicare has been generally, if hesitantly, accepted. It is clear that without computerization the assessment and processing of payments would be difficult, even impossible. Despite this, many patients and physicians are uneasy that sensitive data are in the hands of government, because the possibility of misuse, however remote, exists.

To prevent such a possibility, some steps can be taken. Administrators must make it plain, first, what is the purpose of maintaining this computerized bank of information and, second, that any other use infringes the right of an individual to privacy and confidentiality. Employees should be carefully selected and bonded to ensure competence and integrity. In addition, a code of ethics for centralized health information should be established jointly by the relevant professional societies and subsequently enacted into law; this would ensure that the use of computerized health systems serves both individual and public interests, so far as possible. Finally, manufacturers must design adequate safeguards against threats to privacy.

One such measure is the ID card — a simple measure to provide the "owner" of the file with controlled access to his personal file.

Although no present system of identification is perfectly adequate, some codes are being used in various health and medical systems, as described below.

Identification of patient files

In theory a code should select the patient easily, reliably and without ambiguity. In medical practice, however, an identification code should be a natural code, composed of normal, readily available subject data such as name, sex, marital status and blood group, supported if needed by other, already accepted digits such as social insurance numbers. For example, Kaiser-Permanente medical record codes contain these subject data and nonvarying physiological data such as sex and blood type.

According to Acheson,[2] an identification system must fulfill five principal criteria. A patient's ID must be unique to himself, yet universal in nature, permanent, available and economical.

So far, no system satisfies perfectly all these criteria. One which closely approximates the ideal is that suggested by the Western New York Health Data Network. The network ID card will be issued at the time of registration by an outpatient department, a health department employee or the person appointed at the physician's office. Thus, every patient will receive a plastic card which is divided into four fields, A through D. Field A contains a preprinted identification of the clinically responsible party issuing the card; field B is the identification of the owner; field C is a strip of magnetic tape suitable for machine-recording of data (blood groups, allergy code, immunization code, last updating, diagnostic and therapeutic statements in code forms) and field D is a warning against misuse.

The card contains a 10-digit number assigned by the network which is used for record linkage as the primary search identifier, a data security filter which verifies the validity of the inquiry before processing may continue, the patient's full name, date of birth (month, day, year), sex, current marital status and social security number and the date when the file was opened.

In Europe, national identification codes are employed in several countries.[3,4] Ranging from 10 to 13 digits, most of these include partial codes for sex and birthdate. Some also incorporate initial characters of surname and birthplace and make provision for a check digit. A few countries have a reserve system, used for noncitizens and newborns. These national identification numbers usually do not permit

location of families and are insufficient for genetic and family practice studies.

It should be noted that opposition in the USA and Canada to the use of a national numbering system for identification purposes is usually emotional. Though almost everyone would agree the idea makes sense intellectually and economically it must, nevertheless, be admitted the programs are dehumanizing in practice, and there is always the danger that bureaucrats, confronted by numbers, will tend to forget that they represent real people.

File sharing and protection

The question of who should have access to a medical record or portions thereof is not new, but is more complex if the medical data base is computerized, as the possibility of sabotage looms as larger-scale than in manual file systems.

In Massachusetts a review of pertinent legislation was conducted several years ago,[5] and it was found that there are degrees of file sharing and protection for health records:

- Those not subject to subpoena: clinical psychiatric records, certain research studies and vocational rehabilitation records.
- Those highly restricted: venereal disease records, addiction records, vital statistics and public welfare records.
- Those generally confidental: clinical records of health agencies and physicians.
- Those nonconfidential or public records: dangerous disease, acute poisoning reports, battered child reports and motor vehicle accident reports.

However, it should be noted that this legislation applies only to the public sector and that private users of health information — agencies, businesses, individuals — are not bound by the quasilegal degree of this file protection. One definite improvement needed in this area is the exclusion by law of the selling of any recorded information -- lists of addresses of physicians, for instance — however innocent or profitable it may seem.

Protection of physical files (tapes and discs) and computer equipment is important. One of the most serious threats to computers and physical files is fire. Security is frequently left to data processing technicians who often lack complete authority or background to arrange adequate protection. For this reason, many university and government computer centres would be better off using the services of commercial central station protection companies. A central station, for example, monitors subscribers' premises 24 hours a day to detect fire, intrusion and other dangers to files.

Sabotage too can be a real problem. Computers, medical files and their associated software are vulnerable, for example, to vandalism by disgruntled former employees with real or imagined grievances, by deranged persons or by youngsters looking for thrills, and the damage can result in losses of irreplaceable medical data.

In order to trade off the quick accessing of a medical data base against adequate protection, physicians should carefully analyse what locale and personnel would best provide them with the services they require.

In Canada, government computer centres may be the first choice, because computer centres of government medical plans have accumulated very sensitive data banks on fee-for-service payments to physicians. These computer centres are well protected and staffed by competent professionals. Most of these centres have updated computer configurations, including auxiliary input and output equipment such as optical scanners and microfilm output. University computers may be the next best choice. The risk of vandalism here is much higher, but after some bitter experiences computer centres have now become better protected.

If neither of the above alternatives proves acceptable, and the medical profession decides to run its own computer operation, it must be well-planned rather than the result of haphazard developments based on local initiatives. The need for a policy to be hammered out on this question is evident and urgent.

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Information systems. Part V: what the users think

By J.F. Brandejs, PhD, M.A. Kasowski, MSc, H.O. Murray, FRCS[C]

The medical record of a patient treated for several years contains a considerable amount of data recorded on a seemingly infinite series of forms differing in size, colour and format. Preparation and storage of such records constitutes a major item in health care expenditures.

Increasingly, emphasis has been placed on computerization of medical information as a step toward greater economy and efficiency in record management. However, the impact of most computerized health information systems has to date been limited. Inadequate planning is a major factor in this overall poor performance; the system cannot rise above the level of competence of the design team, which ideally should comprise experts in medicine, computers, management, information retrieval, medical records and hospital activity coordination.

Hospital information systems have seldom been very successful in practice. One problem is preoccupation with nonmedical procedures. For example, in the Missouri regional medical program, 78% of available computer time is taken up by administration and file management, leaving only 22% free for all other applications.

Often, standards for the records of patients treated outside hospital have been set by the relatively few complex cases which arise rather than the simpler requirements of the great majority of such patients. Take, for instance, the Medi-data, IBM's MISP and GE's Medinet systems.

The Medi-data system was designed on the assumption that only specially trained personnel would use the data input-output terminals as this would simplify data reduction and improve accuracy. However, such a provision is fatal as it reduces accessibility of medical information for the decision-maker who needs it most urgently — the physician. Systems like Medi-data fail because they are machine- rather than user-oriented. Practising physicians should be able to put into the system the data they want in the way they want it and be able easily to retrieve it for day-to-day usage, without any special knowledge of the machinery. This requires that systems analysts and engineers be reeducated to think about patient care in the way that doctors do; thus one hopes they would avoid designing a system too elegant to be of use to the medical personnel it is supposed to serve. For example, it is not practical to ask the physician to go through a six-step process to order a simple medication, as the Kaiser system required. Nor is it reasonable to expect physicians to line up for terminals as in some Swedish hospitals.

Medinet was planned to be a regional all-inclusive system. It encountered a problem common to systems with several institutions as users; its comprehensiveness required the hospitals to change their procedures for acquiring data, since the input system was complicated and inflexible. However, it should be obvious that hospitals usually reject systems that require them to make major procedural adjustments; accordingly, Medinet and similar systems should be redesigned to require minimal changes in hospital administration, at least initially. Unless this is accomplished, widespread acceptance and use are unlikely.

Another proposed medical information system, IBM's MISP, ran into problems because program maintenance was simply too complicated. The documentation of the software was confusing and lacked established ground rules. Medical information systems like MISP are intricate in that programs are interrelated and operating systems are complex. Thus, any change requires full knowledge of all aspects of the system, or a nonoperable system may result, which was what eventually happened to MISP.

A system now operational, MIS-1 at El Camino Hospital, Mountain View, California, is made up of subsystems. The first, designed for the business office, includes payroll, patient billing, accounts payable and general ledger. The second, a medical information system, uses visual terminals and lightpens. From various terminals in the hospital a doctor can feed in his code number and observe a display of his current patients. Using the lightpen, he can select a name and give new orders for that patient or review existing orders and results of tests. Any change or renewal initiates a new orders sheet at the patient's nursing station and the pharmacy, laboratory or other departments. If a drug is ordered, a prescription record and a gummed label are automatically printed in the pharmacy, whereas dietary instructions go into a consolidated diet orders list produced in sequence before each meal.

Some follow-up routines also result from medical orders. A medication-due sheet is printed each hour at nursing stations and a daily orders summary shows all newly written and current orders. Reminder notices are issued for overdue tests and medications. Should an order be made for some future time, the requisition will be printed in the department concerned on the date specified. In like manner, test results are fed into the system by the various hospital departments, and the results can be accessed from any terminal in the hospital.

Despite its basic practicality, some problems have hindered the system's general acceptance. Terminals and lightpens were intended to enable doctors easily to input their own orders. However, in practice, many continue to write by hand orders which then must be entered by other staff, defeating the efficiency of the system (as well as

aggravating some of the nurses). Furthermore, certain physicians prefer their orders so formatted that the nurse must not only input the data to the system but also write it up manually for the patient charts. In addition, the number of pages in the patient charts has increased greatly with computerization. Information is scattered on numerous pages instead of in summary form — such as the graphs of vital signs formerly drawn by nurses that often indicated important trends a physician might otherwise fail to observe. Another problem is limited access to the terminal. If a nurse is entering data when a patient calls, she may hesitate to erase her message, answer the call and then later have to start her entry all over again.

Starting December 1971, the internal medicine floor was the first medical department at El Camino to use the system, which was hospital-wide by October 1972. By then more than 2000 changes had been made, and, not surprisingly, of the medical staff, those in internal medicine remain the most strongly opposed to the system. In the summer of 1972, after 6 months of operation, 66% of the internists voted against the system. By January 1973, 60% of the internists continued to oppose the project, but doctors in every other department voted to retain it with a net result of 48% in favour, 42% opposed, and the remaining 10% offering no opinion. Acceptance has since risen further; recently the level was more than 60% for physicians having hospital privileges and almost 100% for the nursing staff.

The main criticisms that have been directed at various medical information systems to date are fourfold:

- Insufficient time devoted to medical as opposed to business functions.
- Machine-oriented rather than user-oriented design.
- Complicated program maintenance.
- Inadequate debugging before installation.

Fortunately, all these difficulties are correctable. With sufficient time and attention focused on their solution, well-accepted medical information systems could soon become operational on a wide scale.■

Information systems. Part VI: what the computer can do for the primary care physician

By J.F. Brandejs, Ph D, M.A. Kasowski, M Sc, M.W.L. Davis, CFCP

After decades of increasing use and training of specialists, the role that the family practitioner who is continuously aware of the health of his patients can play in providing good overall medical care is again being recognized and emphasized by medical schools and the general population. However, several aspects of family practice are onerous; this article points out how computers might lessen the heavy burdens of family practice. As we consider these burdens let us note they are as well common in many specialties, particularly pediatrics and internal medicine.

First, family medicine requires a great deal of general knowledge because uniquely it encompasses health care for all stages of family development — marriage, birth, infancy, childhood, adolescence, adulthood, aging, trauma, illness and death. In Canada, the average practitioner has available only about 12 hours per month to "keep up", forcing him to select what he does read during this time and to look for methods to help him zero in on critical fields in rapid change.

A second difficulty of family practice in contrast to the work of the specialist is lack of the constant intellectual stimulation provided by rare or severe illness. The family doctor encounters rather mundane problems most of the time. His job satisfaction will primarily come, not from his few "interesting" cases, but from understanding his patients and their families as people and his ability to manage most illnesses they acquire — that is, to maintain the health of his patient panel. However, to speculate that few outstanding students would thus select family practice over a specialist career is misleading, because the exercise of intelligence is very different in the two milieux. Family medicine requires a complex, humanistic, problem-solving approach, the mastery of which provides a lifetime of challenge and stimulation for those who still can manage a smile for the miserable tot with a nose cold, even though the last seven cases have been runny-nosed kids.

A third source of frustration — at least for most mortal family physicians — is the financial discrimination favouring specialists over general practitioners in Canada. This situation is under heavy criticism[1] and steps are being taken by organized medicine to balance the discrepancy between family physicians and other specialty groups. Economics obviously influence the willingness of family physicians to organize and take advantage of various medical information systems, and the present financial disparity may well deter this.

Too little time

Fourth, physicians tend to overwork and thus lack time for other activities. Observations of the waking activities[2] of 66 internists and 163 general practitioners in the US show where and how these physicians spend their waking hours. The typical patterns of work of a solo family physician may be summarized as "too many patients". Consulting time per patient of British physicians is 2-10 minutes, averaging 6.5 minutes per patient in August 1966 and 5.5 minutes in February 1966.[3] Within Canada, analyses[4-7] have shown:

- The typical family physician has a great quantity of work daily — 30-60 office visits, hospital visits, surgical assistance, housecalls and roster duties. His free time is sparse, and much time is spent on work-related reading.
- His activities are characterized by variety, fragmentation and brevity.
- Physicians prefer to be involved in problems that are current, specific and ad hoc.
- Physicians strongly prefer informal face-to-face communication, the telephone, formal face-to-face communication and mail and other written communication, in that order.

Business world parallels

This breakdown of physicians' behaviour is similar to that of modern office and plant managers.[8] Such patterns in the business world have been shown over and over again to benefit from judicious employment of systems analysis and computers. It is reasonable to assume careful use of similar methods and technology would improve the working conditions of most doctors.

Now let us look at the actual state of medical information systems (MIS) at work in medical practice. Most useful applications help the physician to keep up with current knowledge, reduce his work load or both. Although it must be admitted there are almost no comprehensive working models operational in private practice, various projects now in progress demonstrate the usefulness of certain aspects of MIS in this field.

Since 1961, for instance, the American Medical Association has been working to develop a single language of medicine. It has published four editions of its "Current Medical Information and Terminology" and two editions of its "Current Procedural Terminology". The AMA is currently studying combining the features of both to develop a common medical language compatible with computer technology. There is considerable debate over the issue of nomenclature, terminology and coding, especially with respect to compatibility among the most widely used systems of medical recording. The plea has been made to integrate them all into one system, with the suggestion that the final result be called a systematized nomenclature of medicine (SNOMED).[9]

Numerous medical institutions have made available questionnaires which a physician can self-administer and have computer-scored and confidentially returned to himself. When designed properly (no small job), these can pinpoint information gaps (sometimes with a computer printout of appropriate references) and indicate to the physician taking the test whether his overall knowledge and practice is up-to-date. These exams are most useful when followed by a special residency program. Many Canadian medical schools offer programs which allow each family physician resident individually to select subjects — care of patients in a coronary unit, counselling of common individual and family problems, geriatrics or preventive medicine, for instance.

The Saskatchewan "dial access" program is typical of many projects which serve practising physicians through modern communications. Recognizing that many of its members were in solo practice in small towns and thus unavoidably deprived of much current literature, the Saskatchewan Medical Association, in collaboration with the University of Saskatchewan medical school (and recently the Saskatchewan Pharmaceutical Association and the provincial department of health as well), has made available to provincial doctors and druggists a comprehensive listing of some 450 cassette tapes on current medical treatment, diagnosis

and practice. These can be played on request, via long-distance telephone, toll free, any time of day or night. Thus allowing for emergencies, as well as routine use. In addition, some 14 experts are available by radiopage for direct consultation, 9 a.m. to 9 p.m. At present the service averages daily three calls for tapes and one for direct consultation. It costs about $10 000 annually to maintain. Tapes are regularly updated, free of charge, by Saskatchewan medical school staff. Interest in the project has been expressed by several other provinces; such a system could likely be extended anywhere telephone communication is available.

The advantages of organizing medical records to achieve ideally an adequate data base on each regular patient have been mentioned several times during this series. There is much controversy over the merits of various proposed formats, particularly the POR (problem-oriented record). Since most Canadian family physicians do not have means of accessing computers but may envisage such a prospect in due course, an effective approach to medical recording may be use of a computerizable extracted summary, to reduce the volume of data and avoid misinterpretation caused by the wide variety in terms. The procedure expedites searches, indexing and retrieval.

In the US, a nation-wide dial-a-diagnosis service is available for physicians who encounter perplexing problems in their practices and need the advice of a specialist. The nonprofit service, Medicall, is operated by the American Society of Contemporary Medicine and Surgery. Medicall began operations at the end of 1972 and averages 6-8 calls per day. About 200 specialists are available 24 hours a day throughout the country to answer queries immediately from practising physicians.

Ledley's statement of 1966 indicates the potentials of computers.

For some time it has become increasingly apparent that electronic computers can aid certain aspects of medical diagnosis and medical data processing. For example, the computer can:

- Produce a list of possible diagnoses consistent with the medical knowledge for a given set of symptoms presented by the patient (for the purposes of this article, we use the terms "symptoms" and "tests" to include medical history, signs, symptoms, laboratory-test results, etc.; that is, these terms include all the information that can be obtained with respect to a patient's medical state and can indicate further diagnostic tests which best differentiate among remaining diagnostic possibilities. It can calculate the probabilities for alternative diagnostic possibilities and can enable the more precise statement and analysis of the value decisions which may be associated with treatment planning.

Such computer applications must be based on extensive medical data; hence, a further use of computers is to compile statistics which relate symptom-disease combinations and which evaluate disease-treatment-prognosis results. These statistics are used in future diagnosis, treatment, and prognosis determinations. In addition, under certain special circumstances, the computer can be an indispensable aid. For example, the computer can make feasible the utilization of more quantitative criteria than has heretofore been possible in the evaluation of the results of certain diagnostic procedures (such as electrocardiograms and electroencephalograms), as well as perform the complicated calculations necessary for the proper interpretation of many other clinical measurements. Finally, the computer can significantly aid the important field of medical-information retrieval. For example, the computer can rapidly retrieve current information about new preventive measures, diagnostic techniques and specific treatments and can accumulate and recall desired aspects of a particular patient's total medical record, such as total radiation dose received, previous allergic reactions, individual biochemical and physiological norms and deviations, etc.[10]

While the above statement deals very largely with potential, large-scale developments, the present use of computers in specific circumstances is well known — for example, computer-aided electrocardiogram interpretation is available.

Cardiovascular Clinic, a group practice of seven cardiologists in Oklahoma City, is an example of a private practice which has integrated into patient care a fully operational medical computing system sensitive to the needs of a dynamic medical practice. The clinical applications are the focal points of the system; business functions are an added feature. The clinical system at present has three components with others to be added as circumstances permit. These are an automated history-taking procedure, an automated medical record and a diagnostic and long-term follow-up system for the treatment of hypertensive patients.

The business system is written around the medical system, and handles both patient scheduling and accounting.

Cost of the system was underwritten entirely by the clinic. The computer system, including hardware (PDP-15 computer with 32K core, a Printek character printer and four teletypes), software and 12 CRT terminals was purchased in 1970 from Meditech in Cambridge MA for $160 000. Development costs included an additional $15 000 for custom software, purchased from Meditech, as well as the cost for one year of programming. Equipment maintenance currently costs $600 a month. The clinic also pays the salary of a full-time programmer.

Surprisingly, the actual cost for the system proved to be what the Cardiovascular Clinic management estimated. In addition, one result of bringing in the system was that fewer personnel were required — one less in scheduling, two fewer in the business office and three less in medical recording.

The physicians agree that the system benefits both themselves and the patients by allowing the doctor efficiently to take better care of the patient, although there is no quantitative evidence of this at present. However, a neat, typed, well organized record for each patient should make it easier for physicians to review a patient's history at each visit and to review each other's practice patterns. The project's most significant contribution has probably been developing a means of improving patient care through the outpatient medical record, without high costs or a large development staff.

Feasibility

Proof of the feasibility of computer-aided health information systems in ambulatory settings is of considerable interest to the Canadian Medical Association, which proposes to coordinate developments in this field across the country through its subcommittee on research in medical economics and systems. Interested groups will organize problem-solving teams of result-oriented practitioners and paramedical staff. Guidance will be provided by the CMA in cooperation with organizations interested. The result should be design and implementation of systems to aid providers of primary care.

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Information systems. Part VII: problem-oriented medical records for family practice

By J.F. Brandejs, Ph D, M.A. Kasowski, M Sc, Louis J. Fortin, MD

Although the concept of the problem-oriented record (POR), as developed by Weed[1,2] and others has been in the literature for several years and has been the subject of a great deal of attention, the application of the principle outside of a very few demonstration models and research centres has been minimal. Why? It may be that many practitioners have assumed that POR requires a sophisticated computer setup.

Certainly POR was developed so it could be (and usually has been) stored on computer. But in fact it is equally adaptable to the ordinary family practitioner's filing cabinet. We have observed such a noncomputerized POR system operating successfully for a small group practice, as will be described later.

For a detailed description of the basic concept of the POR, there is probably no better written, or more interesting text than that of Weed,[3] which most medical students find incorporated somewhere in their studies these days. In short, the patient's medical record is organized in four stages: the data base, problem list, problem treatment plan and progress notes. See Fig. 1 below.

Data base

Let us take the first of these stages. The POR system is based upon the premise that proper, long-term, health care requires the most complete knowledge possible of the patient's overall health status, so that all existing or potential health problems can be treated in context. This knowledge consists of two parts — the subjective medical history of the patient and the findings of a complete physical examination.

It must be admitted that the traditional form of history-taking, in which the physician questions his patients and notes his responses, often has two deficiencies: no standard format is used to ensure that a certain required minimum of information is asked of each person, and the questions asked relate mainly to the presenting complaint. Nevertheless, a personal interview is the only way the physician has of directly evaluating the patient and vice-versa; any possible substitute is detrimental to the doctor-patient relationship.

To help the physician prepare for each patient and avoid the drawbacks of a completely unstructured interview, many problem-oriented practices have new patients complete a self-administered questionnaire (for example, the PROMIS II adult medical history*) several days before their initial interview. The physician then has time to study carefully the patient's responses. He will note those that are abnormal, requiring detailed follow-up; those that indicate from the family history the possibility of problems; those that seem inconsistent (the patient may have answered incorrectly); and those that indicate a need for patient education because of the patient's lack of knowledge or practice of preventive measures.

Questionnaires are often hailed by their salesmen as great timesavers for the overworked physician. Not so — at least not initially. To review carefully

*PROMIS II Adult Medical History Questionnaire available from Systematics, Inc., PO Box 2000, Princeton, NJ.

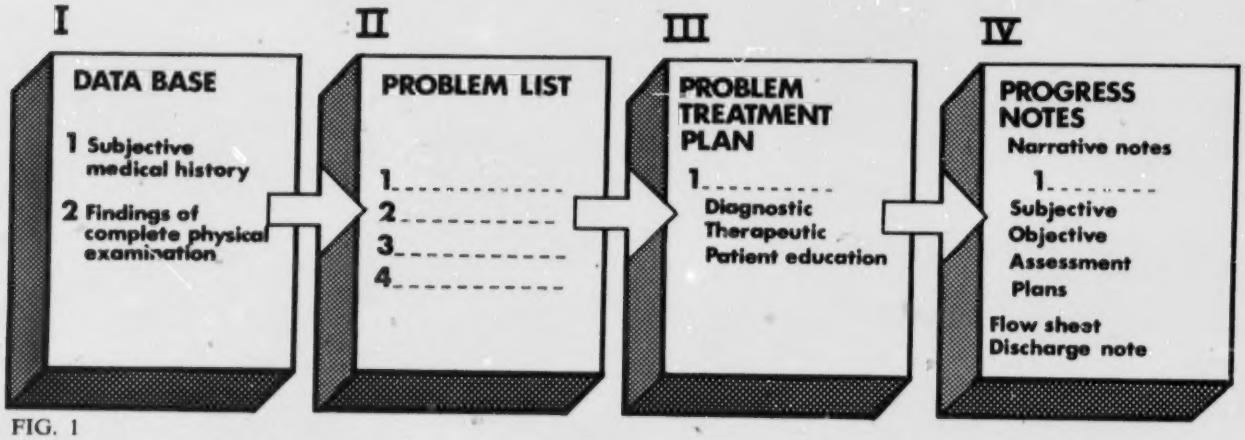

FIG. 1

an answered questionnaire and rigorously follow-up the responses as outlined above is obviously going to take more of a physician's time, not less. The advantages lie rather in the improved quality and completeness of the medical history obtained.

The second part of the POR data base consists of the results of a complete physical examination. Most of this information could be obtained by competent paramedical personnel. Ideally, problem-oriented practices would have patients undergo their physical at the time they complete the questionnaire, so that both the medical history and the results of the physical examination (particularly any abnormalities observed) would be available to the physician for review before his conference with the patient.

Problem list

Having thus completed the POR data base, the physician should as soon as possible draw up a problem list. This will, of course, be modified regularly as more data are available, as results of treatment become apparent, or as more problems appear; but the list should reflect the current analysis of all the patient's health problems as recognized by the doctor, not just the presenting complaint. Weed[1] makes the point that the patient's mental problems are often neglected in this sort of analysis.

This is unfortunate; a depressed mental condition, ignored during treatment of some acute ailment, may account for the total or partial failure of that treatment. The patient's self-esteem may be so low that he may not care enough to take medication regularly, follow his diet or return for a follow-up appointment, any one of which could have serious consequences. This is especially disturbing when one realizes such patient behaviour likely occurs in up to 50% of cases. If a problem list can improve the rate of patient compliance this alone justifies the time and concentration it takes.

Problem treatment plan

The initial problem list may include possibilities that do not prove real after further examination or, vice-versa, may not include some conditions recognizable only after further procedures. What *is* important is to include for each recognized, real or potential problem a plan for its solution. This may be further testing to confirm a tentative diagnosis, treatment of a recognized acute condition, surveillance of a stabilized chronic problem (diabetes for instance) or study of the possible complications should one problem interact with another. To avoid storage difficulties, bulky files of long-term patients may be divided into active and inactive parts. Problems such as episodic or resolved acute illness or trauma should be relegated to the inactive file and so noted on the problem list.

Socioeconomic conditions should not be ignored. Although they are not directly a medical concern, they can obviously affect the outcome of treatment. How, for instance, can one cure recurrent bronchitis in a child who lives in draughty, poorly heated housing? Treatment plans will change with the patient's improvement or lack of it.

Progress notes

Once the problem list and treatment plan have been established, monitoring the resultant progress becomes important. This is done by regularly making progress notes on the various problems listed. It is this aspect of the problem-oriented record that perhaps makes it most useful as an aid to the doctor in keeping his train of thought well organized.

Most manual records have all sorts of progress notes and data crammed together, filed by date of entry only. Problem-oriented records, having material sorted by problems listed, can be more easily used by the doctor in reviewing a patient's condition and modifying his plan if the results are not satisfactory. Such progress recording can become a functional tool of medical practice rather than an historical accumulation of miscellanea, and it makes self-auditing (the most valuable process of all to the conscientious doctor) automatic for all his patient panel.

Given Health Centre, Burlington, Vermont, operates a manual POR system. This group practice, consisting of 6 doctors (3.5 full-time equivalent, as some teach part-time), 2 nurses, 5 other paramedics and 20 clerical workers, serves a patient population of 10 000. New nonemergency patients are seen on first entry by paramedical personnel who administer a battery of physical tests and assist the patient, if necessary, to complete the PROMIS II adult history questionnaire. The completed data base, with red-circling of abnormal responses, is reviewed by the physician before he meets the patient — usually about 2 weeks after the initial visit.

Following his examination of the patient and any required diagnostic follow-up, the physician draws up a problem list and treatment plan. The physicians at Given use the medical record for education of patients, each of whom gets a copy of his record, including treatment plan, besides the usual medical instruction.

To ensure standards are being maintained, all medical and paramedical personnel take part in a weekly medical audit, when about 60 complete PORs are examined. About one-third of the patients have no active health problems. These patients are monitored by a health maintenance exam given by paramedical personnel every 2 years. Patients seem to appreciate being able to see their medical record, and some became Given patients solely for that reason. Apparently no major problems have arisen as a result of the policy, and the staff feels the patients follow through the treatment plan better than they would otherwise do. This conclusion seems reasonable, although the tactic has not yet been evaluated against conventional methods of patient education.

In conclusion, the use of the problem-oriented method of medical recording can pay worthwhile dividends, especially in family practice where the physician is concerned with long-term health maintenance of his patient population. Without this thorough listing of patient's health problems and construction of a plan for coping with each, it is easy to slip into a crisis-oriented practice, ignoring all but the acute problem at hand. While the latter philosophy clearly has its place in hospital emergency rooms, the problem-oriented approach is more consistent with modern preventive practice.

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Information systems. Part VIII: impact on the medical profession

By J.F. Brandejs, PhD, M.A. Kasowski, MSc J.D. Wallace, MD

When automation arrived, it was viewed as a promising tool for levelling the costs of acquiring information as well as improving its quality. As with industry at large, initial efforts with computerization of medicine were unsuccessful in meeting these objectives. A major reason for this was underestimation of the size and complexity of the problems.

The first proposals promised total hospital information systems, solving not only the problems of communication within the hospital but also those of record-keeping and fiscal administration. Even had such proposals been practical, the nature of hospital organization and management would have prevented their successful implementation. Despite such failures at the hospital level, it must be acknowledged that federal-provincial administration of health care is absolutely dependent upon operable computerized information systems to allocate payments as well as support long-term planning and health care decision-making.

Without doubt, it is the introduction of medicare that is responsible for the greatest general impact of computerization upon Canadian doctors, with the subsequent emergence of claim forms, carefully designed for automated, centralized data processing, needing to be filled out and verified by physicians for each patient seen. Although the information supplied is relatively crude, usually much use is made of it in addition to processing physician remuneration. Routine procedures in most provinces include the calculation of individual physician profiles (based on volume of service) and the comparison of these to "norms" established for each kind of practice. Doctors whose performances differ sharply from the norms may be reviewed by committees but the variation from province to province in both the composition of the review committees and the norms themselves relegate the physician profile to being more an item of interest than a quality control measure.

Length-of-stay norms

As provincial data banks accumulate, greater impact for most physicians will result from the trend to establish length-of-stay norms for treatment of various diseases in acute care facilities. Unless sufficiently sensitive to age differences, for example, such standards can create difficulties both for the hospitals and doctors whose case-mixes include a higher proportion of elderly patients. The frustrations of the administrators and physicians involved in such problems are similar to those of us who, one time or another, have received a wrong billing on a credit card account (and who hasn't!). It's very difficult to communicate to a computer the fact that it's made a mistake in your particular case. Since it is the "computer" that has made the error, nobody seems to worry about the situation very much or be in any hurry to solve the problem. However, the development of norms on a provincial or federal basis can and will undoubtedly improve with time as additional data accumulate; thus, the statistical standards should annually become more reliable and, one hopes, more sensitive.

At the hospital level, Canadian doctors have not by and large felt much impact to date from computerization, which has been applied mainly to business procedures. Some of the large teaching hospitals – the Toronto Hospital for Sick Children, for instance — use computers for quasimedical functions such as scheduling admissions on elective surgery. As discussed in Part V of this series, with a few exceptions those hospitals in the US and elsewhere which attempted to use computers in medical applications were unsuccessful, mainly because the systems were batch processing oriented and thus there was always a third party, the programmers and systems analysts, between the computer and the medical personnel. Newer on-line information systems designed to be used by doctors directly in a fashion not too different from traditional note-writing (the light-pen consoles of El Camino for instance) have proved more promising. Their use will likely decrease the level of resistance encountered previously because medical personnel will be directly involved in their application.

For the practising physician in Canada, the computer has yet had little impact upon his routine, other than the changes demanded by medicare. However, within the next few years, it can be expected to assist him to be in a better position to provide care for his patients through more personal attention. It will increase a doctor's time for patient care by simplifying his paper work, patient records, billing procedures and methods of receiving clinical information. With access to a proper technology, a physician willing to use it will have at his fingertips virtually all medical knowledge. Real progress is being made toward reduction of the present variety of record formats for the many different specialties into a standardized, internationally acceptable format that will facilitate further advances in patient care based on computerized medical records.

Office reorganization

Use of standardized formats and the

establishment of a minimum data base for each patient will in all probability lead to some reorganization of a doctor's office procedures. In group practice, and modern family practice in particular, physicians are learning to delegate an optimal amount of repetitive clinical functions to assistants, thus freeing themselves to attend to more complicated aspects of diagnosis and treatment.

Undoubtedly many physicians are undecided as to how to best organize their practices. In his back office each physician most often has a full-time assistant who may be a nurse or an office aid, whom he has trained on the job. It is this individual who works most closely with the physician in direct patient care. There is considerable variability in the degree to which clinical tasks are delegated to this person. In addition, some physicians, seeing a need for a great deal of patient and family counselling in their practices, engage the services of social workers trained in such areas. From a practical standpoint, such individuals could probably best relate to the practices of several family physicians in a group practice or clinic. In some instances, a nurse trained and interested in counselling techniques may assume these duties. Studies in one small North Carolina town have shown that a well-trained physician's assistant or nurse practitioner can save a physician enough time that he could increase the size of his practice by 75% if the demand were present. In the particular practice studied this meant an increase from 220 patients per week to 385 patients per week. It is obvious this sort of office organization will demand real "teamwork" in addition to standardized medical records to avoid becoming chaotic for both patients and staff. However, given the present trend toward formation of relatively large-scale group practices or clinics, the need for meticulous record-keeping, standardized procedures and delegation of routine tasks to appropriately trained paramedical personnel becomes inevitable, and computerization, as discussed, can be expected to aid significantly in the development of this type of practice.

Another trend in modern medicine is the gradual changeover from crisis-oriented medical practice to a preventive approach. Here again the impact of computers can be formidable. Good health care should include health promotion, prevention and counselling to prepare people for various phases of life, education to improve living habits, family planning, specific protective measures such as immunization, further rehabilitative and various other medical and social measures which are within the competence of the physician or require referral to more specialized services. Physicians should be capable of planning and initiating action for patients who seem likely to need attention, rather than waiting for them to present themselves. Such a high level of preventive and rehabilitative care cannot be achieved without a well-organized recall and warning system. For example, a computer-based information system may generate a list of all hypertensive cases under age 50, diabetics with a blood sugar greater than 150 in the 1st year, or, if it is advisable to discontinue use of certain drugs, a list of all patients who are receiving that medication.

Finally, in a philosophical vein, the personal impact of the computer on the individual physician will lie in the required change of the latter's mental processes away from paper (manual-oriented logic). There is considerable disagreement over the question of to what extent doctors should change their traditional work patterns to benefit from automation. (One wishes to avoid the fate of the Australian aborigine who, given a new boomerang, killed himself throwing away the old one.) However, although the capability to use a modern information system is often underestimated, there should be no fundamental stumbling block to doctors. In the end, the main requirement to master the needed skills is an intellect trained to reason and analysis, and this is, or should be, an accurate description of the medical mind.

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